Cat. No. 65-999

OWNER'S MANUAL

Please read before using this equipment

EC-4027

Scientific Calculator

Radio Shack®

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INTRODUCTION

Thank you for purchasing the Radio Shack Scientific Calculator Model EC-4027.
This manual will introduce you to the EC-4027.
Please keep this manual for future reference.

Operational Notes

To ensure trouble-free operation, please observe the following points:

1. Do not carry the calculator in the back pocket of slacks or trousers.
2. Do not subject the calculator to extreme temperatures.
3. Do not drop it or apply excessive force.
4. Clean only with a soft, dry cloth.

If service should be required on this calculator, bring your unit to your local Radio Shack store.

HOW TO PROCEED IF ABNORMAL CONDITIONS OCCUR

If this calculator is subjected to strong external noise or shock during use, a rare condition may occur in which all the keys, including the CA/ON/C key, do not function. In this case, press the **RESET** switch on the back of the calculator. Note that the memory contents will be completely cleared when this operation is performed.

- Press the **RESET** switch only in the following cases:
  - After replacing the batteries
  - To clear all memory contents
  - When an abnormal condition occurs and all keys are inoperative.

DISPLAY

(During actual use all symbols are not displayed at the same time.)

This calculator normally displays only the mantissa of a calculation result. However, if the value to be displayed is outside the range ±0.000000001 to ±9999999999, the display changes to scientific notation. Calculation instructions and symbols are displayed in the Formula Display.

BUSY: Indicates that a calculation is being performed.

M: Indicates that the independent memory is being used.

2ndF: Indicates that the second function (the function shown in yellow above each key) has been specified.

HYP: Indicates that the hyperbolic function has been specified. The symbols **2ndF HYP** appear when the inverse hyperbolic function has been specified.

DEG RAD GRAD:

Indicates the angular unit being used when performing trigonometric functions, inverse trigonometric functions, or coordinate conversion.

FIX SCI ENG:

Indicates the notation used to display a value.

▲ : Indicates which of the following modes is set: algebraic expression reserve (AER) mode, integration mode, statistical mode 1, or statistical mode 2.

←, → : Indicates, in the AER mode, that in addition to the contents shown in the display there are portions not shown to the left (or right) of the display.

ALPHA: Indicates that entry and recall of memory contents and statistics can be performed.

INS: In the AER mode, indicates that the INS mode has been specified.

BEFORE USING THE CALCULATOR

1. Key Notation Used in this Manual

Example:

x^{-1} XOR
[x^2] Key operation
- → [2nd F] [x^{-1}] (Specifies x^{-1}.)
- → [x^2] (Specifies x^2.)
- → [XOR] (Specifies the XOR operation in the binary, octal, and hexadecimal modes.)

2. Power On and Off

Press the [ON/C] key to turn the calculator on, and the [OFF] key to turn it off.

3. Mode Selection

This calculator can operate in any of five operation modes. To select a mode press the [MODE] key followed by the number from [0] to [4] corresponding to the desired mode.

[0] Normal mode:
Used to perform manual calculations such as arithmetic operations and functions. The pointer "▲" does not appear.

[1] AER mode:
Used to store algebraic expressions. The pointer "▲" appears below "1:AER".

[2] Integration mode:
Used to perform numerical integration. The pointer "▲" appears below "2: $\int dx$".

[3] Statistical mode 1:
Used to perform single-variable statistical calculations. The pointer "▲" appears below "3:STAT 1".

[4] Statistical mode 2:
Used to perform two-variable statistical calculations. The pointer "▲" appears below "4:STAT 2".

- When the calculator is in the normal mode and one of the binary, octal, or hexadecimal modes has been specified, the mode cannot be changed. In this case, press the [2ndF] [→DEC] keys to return to the decimal mode and then change the mode.
(See page 19.)

4. Clearing Numeric Values and Calculation Instructions

There are four clearing methods, as follows:

[ON/C] : Clears all numeric values and calculation instructions in the calculator. (Algebraic expressions, integrands, statistics and the values of the independent and temporary memory areas in the normal mode are not cleared.)

[2ndF] [CA] : In each mode, clears all memory contents. (algebraic expressions, statistics, etc.)

[►] : Clears the rightmost digit of an entered numeric value. (Does not function in the AER mode.)

Example: Change the entered value from 123456 to 123478.

123456	***123456.***
[►] [►]	***1234.***
78	***123478.***

[DEL] : In the AER mode, clears the numeric value or calculation instruction at the cursor (*). In other modes, clears the numeric value displayed.

* The symbol "_", the numeric value or calculation instruction flashes at the cursor position.

5. Priority Levels in Calculation

This calculator performs operations according to the following priority levels:

① (–)
② π, memory contents recall
③ Functions that follow a numeric value (x^2, %, →DEG, x^{-1}, $n!$, etc.)
④ y^x, $\sqrt[x]{\ }$, nPr, nCr, →POL, →REC
⑤ Multiplication operations in which the "×" is omitted (2π, 2A, etc.)
⑥ Functions that precede a numeric value (sin, cos, etc.)
⑦ ×, ÷
⑧ +, –
⑨ AND
⑩ OR, XOR, XNOR
⑪ =, M+, M–, STO A~STO F, STO M, DATA, CD, x=M, $x\neq$M, x>M, x<M, $x\geqq$M, $x\leqq$M, →BIN, →OCT, →HEX, →DEC, ►D, ►R, ►G

- If parentheses are used, parenthesized calculations have precedence over any other calculations.

6. Pending Operations

Operations according to the established priority levels or those using parentheses that cannot be performed immediately must be set aside temporarily (pending operations). This calculator can hold up to 8~16 calculation instructions (*) and up to 5 numeric values.

* This calculator has 8 buffers (temporary memory storage locations) for calculation instructions. However, when an opening parenthesis [( ] is entered immediately after a calculation instruction, both the instruction and the parenthesis are stored as one unit. For this reason, this calculator

can hold up to 16 instructions and opening parentheses when using calculation formulas with opening parenthesis.

7. Selection of the Display Notation

This calculator has the following four display notation systems:

① FIXed decimal point system:
The calculation result is displayed with the specified number of decimal places (TAB).

② SCIentific notation system:
The calculation result is displayed using scientific notation ($A \times 10^B$).

③ ENGineering notation system:
The calculation result is displayed using scientific notation ($A \times 10^B$). The exponent is set to a multiple of 3 for display.

④ Floating point system:
If none of the above notation systems is specified, the calculation result is displayed regardless of the number of decimal places specified. None of the FIX, SCI, and ENG indicators appears.
Scientific notation is used if the calculation result is 0 or outside the range $0.000000001 \leqq |x| \leqq 9999999999$.

The display notation is changed by pressing the **FSE** key while the result of the calculation is on the display or after the values in the calculator have been cleared with the **ON/C** key. Each time the **FSE** key is pressed, the display mode changes in the sequence FIX → SCI → ENG → Floating point system → FIX...

8. Determination of the Number of Decimal Places

When the FIX, SCI, or ENG indicator is displayed, the number of decimal places can be set to any value between 0 and 9 by pressing the appropriate numeric key after pressing the [2ndF] [TAB] keys.

Example: [ON/C] [FSE] (Specifies FIX)
[2ndF] [TAB] 9 (Specifies 9 decimal places)
5 [÷] 9 [=] ***0.555555556***
[2ndF] [TAB] 8 (8 decimal places)
0.55555556
[2ndF] [TAB] 7 (7 decimal places)
0.5555556
[2ndF] [TAB] 0 (0 decimal places) ***1.***

(The rightmost digit of the specified number of decimal places is displayed after rounding up 5 and over and rounding down 4 and lower.)

- If a calculation result exceeds the calculation range after rounding, the value is displayed regardless of the number of decimal places specified.

MANUAL CALCULATIONS

- If the FIX, SCI, or ENG indicator is displayed, clear the indicator by pressing the [FSE] key. (See page 7)

1. Arithmetic Operations

Calculation example	Key operations	Display	Notes
45+285 ÷ 3=	45 [+] 285 [÷] 3 [=]	*140.*	
$\frac{18+6}{15-8}$ =	[(] 18 [+] 6 [)] [÷] [(] 15 [−] 8 [=] *	*3.428571429*	
42×(–5)+ 120=	42 [×] 5 [+/−] [+] 120 [=]	*–90.*	
$(5\times10^{3}) \div (4\times10^{-3})$=	5 [EXP] 3 [÷] 4 [EXP] 3 [+/−] [=]	÷ *4.*$^{-03}$ *1250000.*	4×10^{-3}

* A closing parenthesis [)] immediately followed by the [=] or [M+] key can be omitted.

2. Constant Calculations

Arithmetic operations using constants can be performed by following the procedure below:

① Enter the constant value.

② Specify the operator (+, −, ×, ÷).

③ Specify the constant's position by pressing the [►] key. (The constant's position can be changed by pressing the [►] key again.)

④ Enter the input value and press the [=] key.

Calculation example	Key operations	Display	Notes
68×25=	68 [×] [►]		Specify "68×"
	25 [=]	x x ? 1700.	
68×40=	40 [=]	x x ? 2720.	
48−23=	[ON/C] 23 [−]		
	[►] [►] 48 [=]	? − x 25.*	
14−23=	14 [=]	? − x −9.	

* Change the constant's position.

- The "x" and "?" symbols in the display indicate the constant value and the input value, respectively.
- Functions such as y^x and nCr which require two numeric values cannot be used for the input value.
- To quit constant calculations, press [ON/C] .

3. Functions

Before performing function calculations be sure to press the [ON/C] key.

- Before starting calculations, specify the angular unit. (See page 12)

Calculation example	Key operations	Display	Notes
sin60°=	[ON/C] [sin] 60 [=]	0.866025403	DEG
$\cos\frac{\pi}{4}$[rad]=	[ON/C] [cos] [(]	RAD	
	[2ndF] [π] [÷] 4 [=]	0.707106781	RAD
$\tan^{-1}1$=[g]	[ON/C] [2ndF]	GRAD	
	[tan⁻¹] 1 [=]	50.	GRAD

- Chain calculations
  (The result of the last calculation is used as the first operand.)

25+5=30 sin30°=	[ON/C] 25 [+] 5 [=]		DEG	30.	DEG
	[sin]	sin	DEG	30.	
	[=]		DEG	0.5	

- The results of inverse trigonometric functions are displayed within the following range:

	$\theta = \sin^{-1} x$ $\theta = \tan^{-1} x$	$\theta = \cos^{-1} x$
DEG	$-90 \leqq \theta \leqq 90$	$0 \leqq \theta \leqq 180$
RAD	$-\frac{\pi}{2} \leqq \theta \leqq \frac{\pi}{2}$	$0 \leqq \theta \leqq \pi$
GRAD	$-100 \leqq \theta \leqq 100$	$0 \leqq \theta \leqq 200$

Calculation example	Key operations	Display
$(\cosh 1.5 + \sinh 1.5)^2 =$	ON/C hyp cos 1.5 + hyp sin 1.5 = x^2	***20.08553692***
$\tanh^{-1} \frac{5}{7} =$	ON/C 2ndF archyp tan (5 ÷ 7 =	***0.895879734***
$\ln 20 =$	ON/C ln 20 =	***2.995732274***
$\log 50 =$	ON/C log 50 =	***1.698970004***
$e^3 =$	ON/C 2ndF e^x 3 =	***20.08553692***
$10^{1.7} =$	ON/C 2ndF 10^x 1.7 =	***50.11872336***
$\frac{1}{6} + \frac{1}{7} =$	ON/C 6 2ndF x^{-1} + 7 2ndF x^{-1} =	***0.309523809***
$8^{-2} - 3^4 \times 5^2 =$	ON/C 8 y^x 2 +/− − 3 y^x 4 × 5 x^2 =	***−2024.984375***
$(12^3)^{\frac{1}{4}} =$	ON/C 12 y^x 3 y^x 4 2ndF x^{-1} =	***6.447419591***
$\sqrt{49} - \sqrt[4]{81} =$	ON/C √ 49 − 4 2ndF $\sqrt[x]{}$ 81 =	***4.***
$4! =$ $(4 \times 3 \times 2 \times 1 =)$	ON/C 4 2ndF $n!$	***24.*** $n! = n \cdot (n-1) \cdot (n-2) \cdots 2 \cdot 1$
${}_{10}P_3 =$ ${}_nP_r = \frac{n!}{(n-r)!}$	ON/C 10 2ndF nPr 3 =	***720.***
${}_5C_2 =$ ${}_nC_r = \frac{n!}{r!(n-r)!}$	ON/C 5 2ndF nCr 2 =	***10.***

4. Percentage Calculations

Calculation example	Key operations	Display	Notes
500×25%=	500 [×] 25 [2ndF] [%] [=]	*125.*	
120÷400 = ?%	120 [÷] 400 [2ndF] [%] [=]	*30.*	
500+(500×25%)=	500 [+] 25 [2ndF] [%] [=]	*625.*	Surcharge calculation
400−(400×30%)=	400 [−] 30 [2ndF] [%] [=]	*280.*	Discount calculation

- Surcharge and discount calculations cannot be performed within the parentheses.

5. Random Numbers

A pseudo-random number with three significant digits can be generated by pressing the [2ndF] [RANDOM] keys when the calculator is in the normal mode.

- Random numbers use memory F. Each random number is generated on the basis of the value stored in memory F (pseudo-random number series).
- To generate a new series of pseudo-random numbers, clear memory F's contents by pressing the [ON/C] [STO] [F] keys.

6. Angular Unit Conversions

[2ndF] [DRG] :

Specifies the angular unit used when performing trigonometric, inverse trigonometric, and coordinate conversion operations.

Each time these keys are pressed, the angular unit changes in the sequence DEG → RAD → GRAD → DEG →...

DEG: degrees (°)

RAD: radians (rad)

GRAD: grads (g)
*180°= π (rad) = 200g

[2nd F] [DRG▸] :
Changes the angular unit and at the same time converts the displayed value to the specified angular unit.

Calculation example	Key operations	Display
90° → ?[rad] → ?g	90	DEG 90.
	[2nd F] [DRG▸]	▸ R RAD 1.570796327
	[2nd F] [DRG▸]	▸ G GRAD 100.
	[2nd F] [DRG▸]	▸ D DEG 90.
$\sin^{-1}0.8$ = ?° → ?[rad] → ?g	[2nd F] [sin⁻¹]	
	0.8 [=]	DEG 53.13010235
	[2nd F] [DRG▸]	▸ R RAD 0.927295218
	[2nd F] [DRG▸]	▸ G GRAD 59.03344706

7. Memory Calculations

This calculator has one independent memory (M) and six temporary memories (A~F). Memories can hold numeric values with mantissas of up to 10 digits.

[STO] [M] :
Clears the independent memory and then stores the displayed value in the independent memory. The contents of the independent memory can be recalled by pressing the [RCL] [M] or [ALPHA] [M] [=] keys.

[M+] : Adds the displayed value to the value stored in the independent memory.

[2nd F] [M−] :
Subtracts the displayed value from the value stored in the independent memory.

STO **A** ~ **F** :

Stores the displayed value in the specified temporary memory (A~F). Press **RCL** followed by **A** ~ **F** (or press **ALPHA** **A** ~ **F** **=**) to recall the value stored in the memory corresponding to the alphabetic key pressed.

- Numeric values stored in the independent memory are retained even if the operation mode is changed to any mode other than the integration mode.
- A~F memories are available in the normal and AER modes. Temporary memory contents are cleared when modes other than the normal and AER modes are specified.

Calculation example	Key operations	Display	Notes
$24 \div \underline{(8\times2)} = A$ $\underline{(8\times2)}\times5 = B$	8 × 2 = STO M 24 ÷ RCL M = RCL M × 5 =	⇒M 16.M 1.5M 80.M	 A B
23+45+78 = +) 52−31+43 = −) 64+73−12 = (Total)	(Clear memory) ON/C STO M 23 + 45 + 78 M+ 52 − 31 + 43 M+ 64 + 73 − 12 2ndF M− RCL M	⇒M 0. M+ 146.M M+ 64.M M− 125.M M 85.M	 (Answer)
$1 = ¥140 ① ¥33,775 = $?	140 STO A 33775 ÷ RCL A = 	⇒A 140.M 241.25M	 (Answer)
② $2,750 = ¥?	2750 × RCL A =	385000.M	(Answer)
r = 3cm $\pi r^2 = ?$ (A ⇒ r)	3 STO A 2ndF π ALPHA A x^2 =	⇒A 3. (x)* 9. 28.27433388	 (Answer)

* The "(x)" notation indicates that the multiplication symbol "x" is omitted between π and A.

Note:

Calculation results from the functions indicated below are automatically stored in memories E or F. For this reason, when using these functions, be careful with the use of memories E and F.

- Random numbers ..... F memory
- →POL, →REC ..... E memory, F memory

8. Fraction Calculations

[ab/c] : Used to enter a fraction or to convert a fraction to a decimal number.

[2ndF] [d/c] :

Used to convert a mixed number to an improper fraction and vice versa.

- A decimal number or exponent cannot be entered as a fraction.
- Up to six digits for the numerator and up to three digits for the denominator can be entered.
- In the case of mixed numbers, up to three digits for each part (integer, numerator, and denominator) can be entered.
- Including the numerator, denominator, and symbol (┌), up to a total of 10 digits can be entered.
- If the absolute value of a number falls outside the range 1/999~998999/999 or if the number of digits to be displayed is greater than 10, the number is converted to and displayed as a decimal number.

Calculation example	Key operations	Display
$3\frac{1}{2}+\frac{4}{3}$ $=4\frac{5}{6}\left(\frac{29}{6}\right)$	3 [ab/c] 1 [ab/c] 2 [+] 4 [ab/c] 3 [=] [ab/c] [2ndF] [d/c]	*4* ⌟ *5* ⌟ *6* *4.833333333* *29* ⌟ *6*
$\sqrt[3]{2\frac{8}{9}}=$	[ON/C] [2ndF] [3√‾] 2 [ab/c] 8 [ab/c] 9 [=]	*1.424219561*

9. Time Calculations and Decimal ↔ Sexagesimal Conversions

- Time calculations and decimal ↔ sexagesimal conversions can be performed in the normal mode and statistical mode.
- Time calculations using sexagesimal numbers can include the four arithmetic operations, functions and memory calculations.

[D°M'S] : Used to enter sexagesimal numbers and to convert decimal numbers to sexagesimal numbers.

[2ndF] [→DEG] :
Used to convert sexagesimal numbers to decimal numbers.

Depending on the kind of time calculation performed, the calculation result is obtained as a decimal number or as a sexagesimal number.

Addition	sexagesimal	+ sexagesimal	= sexagesimal
	sexagesimal	+ decimal	= decimal
	decimal	+ sexagesimal	= decimal
Subtraction	sexagesimal	– sexagesimal	= sexagesimal
	sexagesimal	– decimal	= decimal
	decimal	– sexagesimal	= decimal
Multiplication	sexagesimal	x sexagesimal	= decimal
	sexagesimal	x decimal	= sexagesimal
	decimal	x sexagesimal	= sexagesimal
Division	sexagesimal	÷ sexagesimal	= decimal
	sexagesimal	÷ decimal	= sexagesimal
	decimal	÷ sexagesimal	= decimal

Calculation example	Key operations	Display	Notes
12°39'18"05 →DEG	12 D°M'S 39 D°M'S 18 D°M'S 5 2nd F →DEG	***12.65501389***	12.65501389°
123.678 → ?(60)*	123.678 D°M'S	***123°40'40.80***	123°40'40"80
3°45'–1.69° =	3 D°M'S 45 — 1.69 = D°M'S	***2°03'36.00***	2°3'36"
sin62°12'24" =	ON/C sin 62 D°M'S 12 D°M'S 24 =	DEG ***0.884635235***	DEG

* Sexagesimal

10. Coordinate Conversions

Coordinate conversions can be performed in the normal mode and the AER mode.

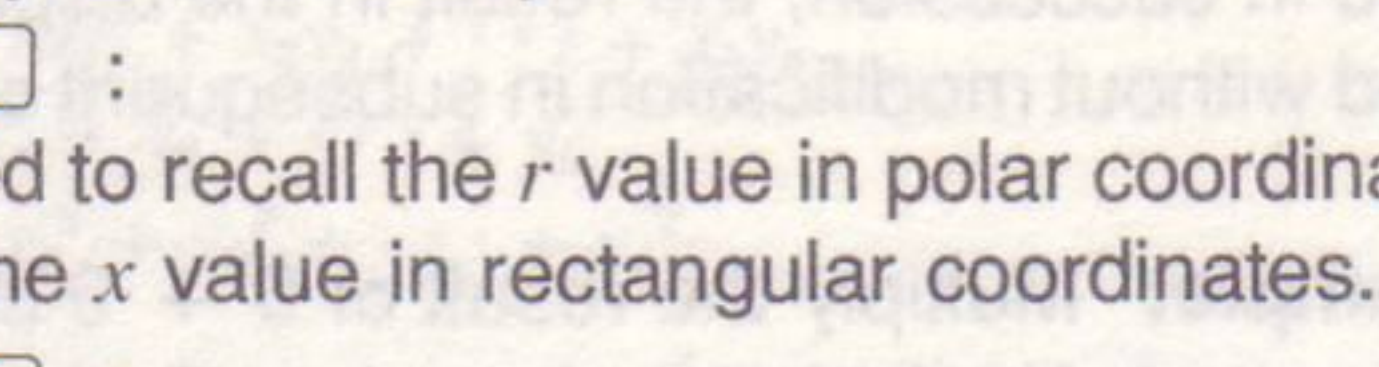
[→POL] : Used to convert rectangular coordinates (x, y) to polar coordinates (r, θ).

[2nd F] [→REC] :
Used to convert polar coordinates (r, θ) to rectangular coordinates (x, y).

- The calculation result is automatically stored in memory E or memory F.

[RCL] [E] :
Used to recall the r value in polar coordinates or the x value in rectangular coordinates.

[RCL] [F] :
Used to recall the θ value in polar coordinates or the y value in rectangular coordinates.



(Rectangular coordinates) (Polar coordinates)

- Before performing a calculation select the angular unit. (See page 12)

Calculation example	Key operations	Display	Notes
$x = 6 \quad r = ?$ $y = 4 \rightarrow \theta = ?$	6 [→POL] 4		DEG
	[=]	***7.211102551***	r
	[RCL] [F]	F ***33.69006753***	θ
	[RCL] [E]	E ***7.211102551***	r
$r = 14 \quad x = ?$ $\theta = \frac{\pi}{5} \rightarrow y = ?$	14 [2ndF] [→REC]		RAD
	[(] [2ndF] [π]		
	[÷] 5 [=]	***11.32623792***	x
	[RCL] [F]	F ***8.228993532***	y

11. Modify Function (MDF)

This function converts a calculation result stored in the calculator to match the calculation result shown in the display. In this calculator, operations are internally obtained in scientific notation ($A \times 10^B$) with an accuracy of up to 12 digits for the mantissa. For this reason, ordinary calculations are performed using values stored in the calculator, not those on the display.

By using the modify function while performing operations in which previous calculation results are used in succession, the result in the display can be used without modification in subsequent operations.

Example: Multiply the result of 5 ÷ 9 by 9.
(1 decimal place has been specified using FIX)

[FSE] [2ndF] [TAB] 1

- Ordinary calculation

5 [÷] 9 [=] ***0.6***
[×] 9 [=] ***5.0***

- Calculation with the modify function

5 [÷] 9 [=] [2ndF] [MDF] ***0.6***

[×] 9 [=] ***5.4***

12. Binary, Octal, Decimal, and Hexadecimal Conversions and Calculations

In the normal mode this calculator can perform conversions and arithmetic operations (including operations with parentheses and memory operations) with numeric values expressed in the binary, octal, decimal and hexadecimal notations.

[2ndF] [→BIN]:

Specifies the binary mode and converts the displayed value to a binary number.

[2ndF] [→OCT]:

Specifies the octal mode and converts the displayed value to an octal number.

[2ndF] [→HEX]:

Specifies the hexadecimal mode and converts the displayed value to a hexadecimal number.

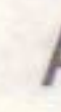
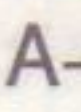
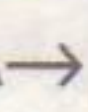
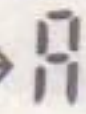
[2ndF] [→DEC]:

Specifies the decimal mode and sets the calculator to the normal calculation mode. In addition, converts binary, octal, and hexadecimal numbers on the display to decimal numbers.

[A] ~ [F] :

Used in the hexadecimal system to input the numbers equivalent to decimal numbers 10 to 15.

[A] ~ [F] are displayed as follows:

A→, B→, C→  , D→  , E→  , F→ 

[NEG] : Used to obtain negative numbers in the binary, octal, and hexadecimal modes. The negative number thus obtained is expressed as a complement (complement of a cardinal number) in the designated number system.

Example: Find the complement of 111 (binary number).

MODE 0

2ndF →BIN NEG NEG *0.*^{b}

111 = *1111111001.*^{b}(–7)

- When a value having a fractional part (decimal number) is converted into a binary, octal, or hexadecimal number, the fractional part will be truncated and only the integer part will be converted.

13. Logic Operations

Logic operations AND (logic product), OR (logic addition), NOT (negation), XOR (exclusive logic addition), XNOR (negation of exclusive logic addition) can be performed in the binary, octal, and hexadecimal modes.

The truth table for the logic operations is shown in the following:

A	B	A AND B	A OR B	A XOR B	A XNOR B
0	0	0	0	0	1
1	0	0	1	1	0
0	1	0	1	1	0
1	1	1	1	0	1

A	NOT A
0	1
1	0

Calculation example	Key operations	Display	Notes
DEC(25)	ON/C 2ndF →DEC		DEC
→ BIN	25 2ndF →BIN	→BIN *11001.*^{b}	BIN
	ON/C 2ndF		
HEX(1AC)	→HEX 1AC	*1AC.*^{H}	HEX
→ BIN	2ndF →BIN	→BIN *110101100.*^{b}	BIN
OCT	2ndF →OCT	→OCT *654.*^{0}	OCT
DEC	2ndF →DEC	→DEC *428.*	DEC

Calculation example	Key operations	Display	Notes
BIN (1010–100) ×11 =	ON/C 2ndF →BIN (1010 — 100) × 11 =	*110.*[b] *10010.*[b]	BIN
HEX(1FF) +OCT(512) = HEX(?)	ON/C 2ndF →HEX 1FF 2ndF →OCT + 512 = 2ndF →HEX	*1511.*[0] →DEC *349.*[H]	HEX OCT HEX
2FEC– 2C9E = (A) 2000–1901 = (B) (A)+(B)=(C)	ON/C STO M 2ndF →HEX 2FEC — 2C9E M+ 2000 — 1901 M+ RCL M	M+ *34E.*[H M] M+ *6FF.*[H M] M *A4d.*[H M]	HEX (A) (B) (C)
1011 AND 101 =	ON/C STO M 2ndF →BIN 1011 AND 101 =	*1.*[b]	BIN
5A OR C3 =	ON/C 2ndF →HEX 5A OR C3 =	*db.*[H]	HEX
NOT 10110 =	ON/C 2ndF →BIN NOT 10110 =	*1111101001.*[b]	BIN
24 XOR 4 =	ON/C 2ndF →OCT 24 XOR 4 =	*20.*[0]	OCT
B3 XNOR 2D =	ON/C 2ndF →HEX B3 XNOR 2D =	*FFFFFFFF61.*[H]	HEX

ALGEBRAIC EXPRESSION RESERVE (AER) CALCULATIONS

The AER (Alegebraic Expression Reserve) inputs a value (variable) in the normal mode and automatically performs calculations according to a calculation procedure previously programmed in the AER mode.

To program algebraic expressions, set the AER mode by pressing the [MODE] [1] keys.

1. Calculation Procedure

The AER area can be divided into two areas. Algebraic expressions can be registered in each area as long as memory is available (40 steps for the entire AER area).

① After specifying the AER mode, specify either area by pressing the [2ndF] [1:] keys or the [2ndF] [2:] keys.

- To program a new algebraic expression, clear the previous one by pressing the [2ndF] [CA] keys. (See page 26.)

② Specify the memories (A ~ F, M) that will hold the variables, and input the formula.

③ Solve for the algebraic expression by pressing the [ENT] key or the [MODE] [□] [2ndF] [1:] ([2:]) keys.

Example 1: Register the following algebraic expression in area 1 and solve:
$40^2 + A (\ln B + \ln 0.5)$

Key operations	Display	Notes
[ON/C] [2ndF] [→DEC] [MODE] 1	1: _	AER mode
40 [x^2] [+] [ALPHA] [A]	←A _	
[(] [ln] [ALPHA] [B] [+]	_	
[ln] 0.5 [)]	←) _	*
[ENT] (or [MODE] 0		
[2ndF] [1:])	A? *0.*	

* Program completed

Solve for when A=3, B=4.

Key operations	Display
	A? *0.*
3 ENT	B? *0.*
4 ENT	ANS *1602.079442*

Example 2: Find the value of the expression $3A^2 + 7A + 9$ for $A = 0, 1, 2$:

- When registering two or more expressions in a single AER area, press 2ndF ␣ or 2ndF , to indicate the separation between expressions.

2ndF , : Displays the calculation result of the immediately previous formula.

2ndF ␣ : Solves the next expression without displaying the calculation result.

Program listing: 2: A+1⇒A, $3A^2$+7A+9

Key operations	Display	Notes
MODE 1 2ndF 2:	2: _	
ALPHA A + 1 STO A	←⇒A _	
2ndF , 3 ALPHA A		
x^2 + 7 ALPHA A + 9	←+ *9.*	Program completed
ENT (or MODE 0		
2ndF 2:)	A? *3.*	
0 ENT	ANS *1.*	Value of A+1 (0+1)
ENT	ANS *19.*	Value for when A=1
ENT	A? *1.*	Value of A
ENT	ANS *2.*	Value of A+1 (1+1)
ENT	ANS *35.*	Value for when A=2

- The ANS display initially shows the A value followed by the result of a calculation formula.
* When solving for a programmed algebraic expression, this calculator retains the entered value as a variable until the next value is input. This numeric value is displayed while the calculator is solving for the expression.

2. Conditional Function

The conditional function changes the execution path of a calculation on the basis of the result of a comparison between the calculation result (x) and the contents of independent memory (M). After pressing the [2ndF] key, specify the condition by pressing the appropriate conditional instruction key ([x=M], [$x\neq$M], [$x<$M], [$x>$M], [$x\leqq$M], [$x\geqq$M]). When the condition is satisfied, the calculator returns to the start of the program and the calculation is repeated.

- Separate formulas by specifying conditional instructions instead of using the formula separators [,] and [⊔].
- Memory M can only store a mantissa of up to 10 digits. When the mantissa of a calculation result exceeds 10 digits, specify the conditional instruction after entering the calculation result into one of the A~F memories.

Example 3:

What is the power to which a number has to be raised to exceed the value of 1000?

Assuming that B=2, and M=1000, find the integer value A for which $B^A \geqq M$.

The initial value for A is 0, which is increased in increments of 1. The calculation is repeated until the condition is satisfied. The result is stored in memory C.

- Program listing:

1: M⊔A+1⇒A⊔By^xA⇒C $x<$M ⊔A

- AER

Key operations	Display
MODE 1 2ndF CA ENT	
ALPHA M 2ndF ⊔	←⊔ _
ALPHA A + 1 STO A	←=A _
2ndF ⊔ ALPHA B y^x	$\leftarrow y^x$ _
ALPHA A STO C 2ndF x<M	←x<M _
2ndF ⊔ ALPHA A ENT	M? *0.*

- Calculation execution

Key operations	Display	Notes
1000 ENT	A? *0.*	
0 ENT	B? *0.*	
2 ENT	BUSY*	
	ANS *10.*	(Answer)

* In the previous example, press ON/C if the computer enters an endless loop. (See page 27.)

3. Remaining Memory

The remaining memory available for use can be confirmed with the 2ndF M.CK keys. The remaining memory available at any given time is displayed while the M.CK key is held down.

- The entire AER area is limited to 40 steps. Try to use the memory area efficiently by omitting symbols that can be omitted, such as "x" and parentheses, and storing numeric values in memory.

4. Correcting Algebraic Expressions

① Specify the AER area (2ndF 1: or 2ndF 2:) in the AER mode. The algebraic expression is displayed.

② Move the cursor to the character to be corrected using the ◄ and ► keys and input the correct symbol, letter, or number.

DEL : Deletes the symbols, letters, or numbers being displayed.

- If instructions between numeric values are deleted, the symbol "[_]" (*) is automatically displayed. Deletion is no longer possible after this point. To continue deleting the expression to the right of the symbol "[_]", move the cursor with the ► key and press the DEL key.

2ndF INS :

- The symbol "INS" appears when the 2ndF INS keys are pressed. (The INSertion mode is specified.) To cancel INS, press 2ndF INS again.
- When INSertion mode is specified, symbols, letters, and numeric values can be inserted at the cursor position.

③ After completing all corrections, press the ENT key.

* When, as a result of editing a program, two numeric values become adjacent, the "[_]" symbol is automatically inserted. If a calculation is attempted in this condition, an "**Er1**" error occurs.

5. Deleting Algebraic Expressions

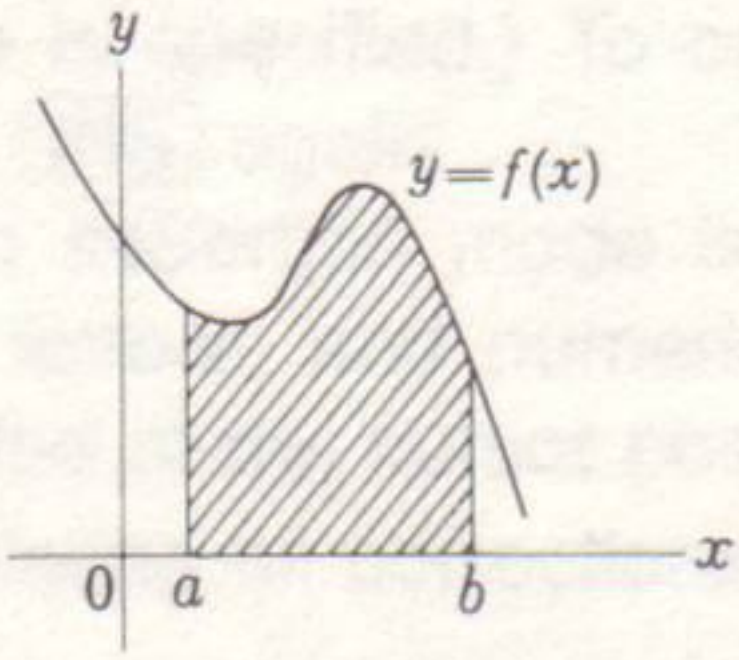
Specify the AER area in the AER mode, and then press the 2ndF CA ENT keys.
All expressions in the specified area will be deleted at this time.

6. Break Function

Press the [ON/C] key if you wish to interrupt a calculation that uses the AER. At this time the calculation is interrupted before completion (break), and "**0.**" will be displayed. Use this function to stop execution, for example, if a program with conditional instructions has entered an endless loop.

NUMERICAL INTEGRATION CALCULATIONS

This calculator can determine the approximate value of $\int_a^b f(x)\,dx$. When numerical integration is performed, the x variable in the $f(x)$ function varies from a to b, as indicated by the shaded area under the function curve $y = f(x)$ in the figure below. The function $f(x)$ is called the integrand and x is called the integration variable. The interval between the lower integration limit a and the upper integration limit b is called the integration interval.



This calculator divides the integration interval into n subintervals and finds the result by applying Simpson's rule. Integrand entry, correction and deletion are performed with the MODE 1 keys in the AER mode. Numerical integration calculation is performed by pressing the MODE 2 keys to enter the integration mode.

1. Calculation Procedure

The integrand shares the memory area with the AER. Therefore the integrand program's length is limited to 40 steps. Press the 2ndF CA keys to clear the memory contents and start a new calculation.

① Enter the integrand with a variable in memory M in the AER mode.

② Change to the integration mode by pressing MODE 2, and specify the area with 2ndF 1: or 2ndF 2: .

③ Enter the lower integration limit (a) and press the [ENT] key.

④ Enter the upper integration limit (b) and press the [ENT] key.

⑤ Enter the number of subintervals (n) and press the [ENT] key.

⑥ The calculation result is displayed by pressing the [ENT] key. (This takes several seconds.)
If you press the [ENT] key again, the calculator prompts for a new entry of the lower integration limit (a). A new calculation can be performed by changing the integration limits and the number of subintervals. (If the [ENT] key is pressed without entering new values, the same calculation is repeated.)

- When the integrand is a periodic function, perform the calculation for one period. When the integral alternates between positive and negative values according to the integration interval, calculate the positive and negative areas separately.
- The time required for integration increases as the number of subdivisions increases because of the increased number of iterations. (BUSY appears while the calculator is computing.) To interrupt integration during computation, press the [ON/C] key.
- In general, the calculation accuracy will increase as n increases. (The calculation error decreases.) However, the accuracy depends to a great extent upon the type of integrand or the specified integration interval.
- Independent and temporary memories are used during numerical integration calculations. Since these memory areas can only hold mantissas of up to 10 digits, calculation errors can occur that are relatively large compared to other types of calculations.

- Calculation ranges are as follows:
  Integral interval (a, b): $|a - b| < 10^{100}$
  Number of subintervals (n): $1 \leqq n \leqq 4999999999$
  (n, integer)

2. Calculation Formula

$$S = \frac{1}{3} h \{ f(a) + 4 \{ f(a + h) + f(a + 3h) + \cdots + f(a + (N - 1)h) \} + 2\{ f(a + 2h) + f(a + 4h) + \cdots + f(a + (N - 2)h \} + f(b) \}$$

$$h = \frac{(b - a)}{N}$$

$$N = 2n$$

- In the formula above, an error will occur if the absolute value of an intermediate result or calculation result is 10^{100} or more.

Example:

Find the value of $\int_2^8 (x^3 - 0.5x^2 + 6)dx$. Use $n = 10$.

① Enter the integrand.

- Program listing: 1: My^x3 – 0.5Mx^2 + 6
  (Variable x is stored in memory M)

Key operations	Display
MODE 1 2ndF 1: 2ndF CA	CL?
ENT	1: _
ALPHA M y^x 3 —	
0.5 ALPHA M x^2 + 6	←+ 6.
ENT	M? 0.

② Perform the calculation.

Key operations	Display	Notes
MODE 2 2ndF 1:	1:?	Integration mode
ENT	a? 0.	a
2 ENT	b? 0.	b
8 ENT	n? 0.	Number of subintervals
10 ENT	BUSY	
	$\int dx$ 972.	(Answer)

- Memories A~F cannot be used for the integrand.

3. Integrand Verification, Correction, and Deletion

An integrand can be verified, corrected, and deleted by performing the same operations used for verifying, correcting, and deleting arithmetic expressions on page 25.

STATISTICAL CALCULATIONS

This calculator performs single-variable statistical calculations in statistical mode 1 (MODE 3), and two-variable statistical calculations in statistical mode 2 (MODE 4).

1. Statistical Mode 1 (Single-Variable Statistical Calculations)

① Statistics calculated in statistical mode 1

$\bar{x}$	Mean of samples (x)
sx	Sample standard deviation (x)
σx	Population standard deviation (x)
n	Number of samples
Σx	Sum of samples (x)
Σx^2	Sum of square of samples (x)

② Single-variable data entry

Data DATA

Data × frequency DATA

(To enter multiples of the same data)

2. Statistical Mode 2 (Two-Variable Statistical Calculations)

① Statistics calculated in statistical mode 2

In addition to the basic statistics calculated for single-variable data, the following basic statistics are obtained:

$\bar{y}$	Mean of samples (y)
sy	Sample standard deviation (y)
σy	Population standard deviation (y)
Σy	Sum of samples (y)
Σy^2	Sum of square of samples (y)
Σxy	Sum of products of samples (x, y)
r	Correlation coefficient
a	Coefficient a in single-variable regression equation $y = a + bx$
b	Coefficient b in single-variable regression equation $y = a + bx$

In addition, an estimate of y for a given x and an estimate of x for a given y are calculated.

② Two-variable Data Entry

Data x [(x,y)] Data y [DATA]

Data x [(x,y)] Data y [×] frequency [DATA]

(To enter multiples of the same data x and y)

3. Data Correction

- Correction prior to pressing the [DATA] key
  Delete incorrect data with the [ON/C] key. If you have not pressed the [×] or [(x,y)] keys after entering an incorrect value, this value can be corrected with the [DEL] or [►] key.
- Correction after pressing the [DATA] key
  If you have not entered any numeric values after pressing the [DATA] key, delete the incorrect data with the [2ndF] [CD] keys. If you have performed any other operation after pressing the [DATA] key, reenter the data to be corrected and press the [2ndF] [CD] keys.
- By pressing the [DATA] key, multiples of the same data can be entered.

4. Calculation Examples

Example 1: Single-variable statistical calculation
Find basic statistics for the following data:

Points	30	40	50	60	70	80	90	100
Number of students	2	5	4	6	11	13	7	2

Key operations	Display		Notes
[MODE] 3			
30 [×] 2 [DATA]	n	*2.*	n
40 [×] 5 [DATA]	n	*7.*	
50 [×] 4 [DATA]	n	*11.*	
60 [×] 6 [DATA]	n	*17.*	

Key operations	Display	Notes
70 × 11 DATA	n 28.	
80 × 13 DATA	n 41.	
90 × 7 DATA	n 48.	
100 × 2 DATA	n 50.	
RCL $\bar{x}$	$\bar{x}$ 69.2	$\bar{x}$
RCL σx	σx 17.7583783	σx
RCL Σx	Σx 3460.	Σx
RCL Sx	sx 17.93867103	Sx
x^2	x^2 321.7959184	Sx^2

Example 2: Two-variable statistical calculation

Two-variable data is available in the format given in the table below. Calculate basic statistics for data x and y, simple linear regression coefficients, and the correlation coefficient between x and y.

x	12	18	8	20	19	15
y	24	36	10	46	35	25

Key operations	Display	Notes
MODE 4		
12 (x,y)	, 0.	
24 DATA	n 1.	n
18 (x,y) 36 DATA	n 2.	
8 (x,y) 10 DATA	n 3.	
20 (x,y) 46 DATA	n 4.	
19 (x,y) 35 DATA	n 5.	
15 (x,y) 25 DATA	n 6.	
RCL a	a −10.28571428	a
RCL b	b 2.583850932	b
RCL r	r 0.961369932	r
RCL Sx	sx 4.633213428	Sx
RCL Sy	sy 12.45257671	Sy

After completing the data entry, as shown on the previous page, perform the following operations:

Calculation example	Key operations	Display
$x=3 \rightarrow y'=?$	3 [y']	y' **–2.534161489**
$y=46 \rightarrow x'=?$	46 [x']	x' **21.78365385**

5. Calculation Formulas

In the following formulas, an error will occur when:

- The absolute value of the intermediate result or calculation result is equal to or greater than 10^{100},
- The denominator (divisor) is zero,
- An attempt was made to take the square root of a negative number.

$$\bar{x}=\frac{\Sigma x}{n} \qquad \bar{y}=\frac{\Sigma y}{n}$$

$$sx=\sqrt{\frac{\Sigma x^2-n\bar{x}^2}{n-1}} \qquad sy=\sqrt{\frac{\Sigma y^2-n\bar{y}^2}{n-1}}$$

$$\sigma x=\sqrt{\frac{\Sigma x^2-n\bar{x}^2}{n}} \qquad \sigma y=\sqrt{\frac{\Sigma y^2-n\bar{y}^2}{n}}$$

$$\Sigma x = x_1 + x_2 + \cdots + x_n$$
$$\Sigma x^2 = x_1^2 + x_2^2 + \cdots + x_n^2$$
$$\Sigma xy = x_1y_1 + x_2y_2 + \cdots + x_ny_n$$
$$\Sigma y = y_1 + y_2 + \cdots + y_n$$
$$\Sigma y^2 = y_1^2 + y_2^2 + \cdots + y_n^2$$

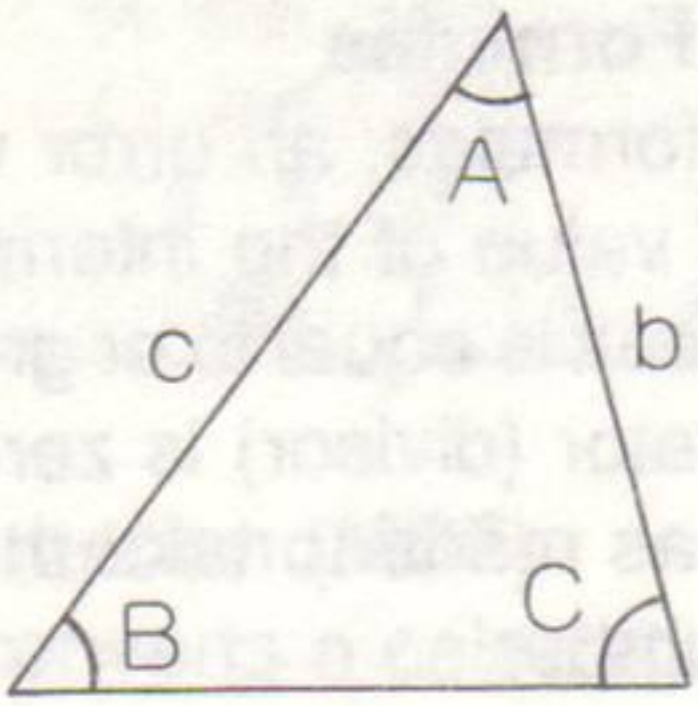
(n: number of samples)

- Since A~F memories are used during statistical calculations, calculation errors may occur.

APPLICATION EXAMPLES

1. Solution of a Triangle

The values of all three sides and three angles of a triangle can be determined by using the sine theorem and cosine theorem when certain conditions are satisfied. These conditions include knowing at least the values of two sides and the angle that they form, or the values of two angles and one side.



In the examples below, memory variables are set as follows:

A	Size of angle A (A) (Unit: DEG)
B	Size of angle B (B) (Unit: DEG)
C	Size of angle C (C) (Unit: DEG)
D	Size of side a (a)
E	Size of side b (b)
F	Size of side c (c)

- Given two angles and one side of a triangle, find the remaining angle and sides (the sine theorem is used).

  Sine theorem:

  $$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

  Program listing:

  180–A–B⇒C, DsinB÷sinA⇒E, DsinC÷sinA⇒F

  Value of angle C　　Value of side b　　Value of side c

Example: Find the values of sides b and c when A=30°, B=60°, and a=1.

Calculation execution

Key operations	Display	Notes
MODE 0		DEG
2ndF 1: (2:)	A? *0.*	
30 ENT	B? *0.*	
60 ENT	ANS *90.*	Value of angle C
ENT	D? *0.*	
1 ENT	ANS *1.732050808*	Value of side c
ENT	ANS *2.*	Value of side b

2. Heron's Formula

Calculate the area of a triangle using Heron's formula:

$$S = \sqrt{s(s-a)(s-b)(s-c)} \quad (\text{where } s = \frac{a+b+c}{2})$$

If the three sides of the triangle are stored as memory variables A, B, and C, the area of the triangle S can be expressed as:

$$S = \sqrt{D(D-A)(D-B)(D-C)} \quad (\text{where } D=(A+B+C)\div 2)$$

Program listing:

```
(A+B+C)÷2⇒D⌊√(D(D–A)(D–B)(D–C)
```

Example: Calculate the area of a triangle with sides A=5, B=7, and C=8.

Calculation execution

Key operations	Display	Notes
MODE 0		
2ndF 1: (2:)	A? *0.*	
5 ENT	B? *0.*	
7 ENT	C? *0.*	
8 ENT	ANS *17.32050808*	(Answer)

3. Parabolic Motion (Loop Structure Formula)

Set up the memory variables as shown below and calculate the time it takes for an object to drop from its trajectory peak to its initial height or just below its initial height, that height, and the horizontal distance from its starting point.

A(m/s)	Initial velocity
B(°)	Angle (Unit: DEG)
C(m)	Height of launching point
F(s)	Time
D(m)	Position (distance) after F seconds.

Calculation formulas

$$x = V_0 \cos a_0 \bullet t$$

$$y = V_0 \sin a_0 \bullet t - \frac{1}{2}gt^2 + h$$

Program listing:

C ⇒ M ⊔ F + 0.1 ⇒ F⊔ FA sinB − 0.5 × 9.8F² + C
⇒ D x > M F, D, FA cosB

Example: A body is launched from a height of 4 meters at an angle of 45° and at an initial velocity of 30 m/s. Calculate the time it takes for an object to drop from its trajectory peak to its initial height or just below its initial height, that height, and the horizontal distance from its starting point. (Use 0.1 sec. as the time unit.)

Key operations	Display		Notes
2ndF 1: (2:)	C?	*0.*	
4 ENT	F?	*0.*	
ENT	A?	*0.*	
30 ENT	B?	*0.*	
45 ENT	ANS	*4.4*	(Time)
ENT	ANS	*2.474095117*	(Height)
ENT	ANS	*93.33809512*	(Distance)

4. Impedance of a Series RCL Circuit

Calculate the impedance of a series RCL circuit by using the following formula:

$$Z = \sqrt{R^2 + (\omega L - 1/\omega C)^2}$$

(where $\omega=2\pi f$)

Set the memory variables as follows:

A	DC resistance (R) (Unit: Ω)
B	Inductance (L) (Unit: H)
C	Capacitance (C) (Unit: F)
F	Frequency (f) (Unit: Hz)
ANS	Total impedance (Z) (Unit: Ω)

Program listing:

$$\sqrt{\quad}(A^2 + (2\pi FB - (2\pi FC)^{-1})^2$$

Example: Calculate the impedance of a series circuit operating at 21 MHz that has the following parameters: Series resistance = 2Ω, inductance = 14μH, capacitance = 4pF.

Calculation execution

Key operations	Display		Notes
2ndF 1: (2:)	A?	*0.*	DEG
2 ENT	F?	*0.*	
21 EXP 6 ENT	B?	*0.*	
14 EXP +/- 6 ENT	C?	*0.*	
4 EXP +/- 12 ENT	ANS	*47.48735835*	(Answer)

QUICK REFERENCE GUIDE

1. Angular Unit/Display Mode Setting

① Angular units (DEGree → RADian → GRAD)

2nd F DRG

② Display mode (FIXed decimal point → SCIentific notation → ENGineering notation → Floating decimal point)

FSE

③ Specification of number of decimal places

2nd F TAB 0~9

2. Normal Mode (Scientific Calculations, Binary, Octal, and Hexadecimal Operations)

① Normal mode specification

MODE 0

② Binary mode specification/conversion

2nd F →BIN

③ Octal mode specification/conversion

2nd F →OCT

④ Hexadecimal mode specification/conversion

2nd F →HEX

⑤ Decimal mode specification/conversion

2nd F →DEC

⑥ Calculation procedure

- Functions that follow its variable value

  Example: sin30° sin 30 =

  DEG 0.5

- Functions that precede its variable value

  Example: 12^2 12 x^2

  144.

- Two-variable functions

  Example: 2^{16} 2 [y^x] 16 [=]

65536.

⑦ Constant calculations

Example: Constant calculations with divisor x = 10

10 [÷] [▶] [▶] 30 [=]

? ÷ x	0.
? ÷ x	3.

⑧ Time (degrees, minutes, seconds) entry and conversion

- Entry of a sexagesimal number

  Example: 12 hrs. 56 min. 34.99 sec.

  12 [D°M'S] 56 [D°M'S] 34 [D°M'S] 99

12°56'34.99

  Example: sin 33°12'54" (DEG)

  [sin] 33 [D°M'S] 12 [D°M'S] 54 [D°M'S] [=]

0.547782269

- Conversion from sexagesimal to decimal

  Example: Convert 48 hrs. 31 min. 21 sec. to a decimal number (48.5225°)

  48 [D°M'S] 31 [D°M'S] 21 [2ndF] [→DEG]

48.5225

- Conversion from decimal to sexagesimal

  Example: Convert 1.5123 hrs. to a sexagesimal number (1 hrs. 30 min. 44.28 sec.)

  1.5123 [D°M'S]

1°30'44.28

⑨ Fraction entry

- Calculation: $1\frac{2}{3} + \frac{4}{5}$

1 [ab/c] 2 [ab/c] 3 [+] 4 [ab/c] 5 [=]

2⌐7⌐15.

- Fraction ↔ decimal number conversion

[ab/c]

2.466666667

- Mixed number ↔ improper fraction conversion

[2ndF] [d/c]

37⌐15.

3. Algebraic Expression Reserve (AER) Mode

① Registering algebraic expressions

Example: $\sqrt{A} + B^2$

[MODE] 1 [2ndF] [1:] [√] [ALPHA] [A] [+] [ALPHA] [B] [x^2]

② Solution

Example: A=9, B=5

[MODE] 0 [2ndF] [1:] 9 [ENT] 5 [ENT]

ANS 28.

③ Deleting algebraic expressions

[MODE] 1 [2ndF] [CA] [ENT]

④ Others

- AER area change [2ndF] [1:] ([2ndF] [2:])
- Displaying or clearing "INS". [2ndF] [INS]
- Separation codes
  - Without displaying each calculation result

    [2ndF] [⊔]
  - With displaying each calculation result

    [2ndF] [,]

- Conditional instructions
  (Compares a calculation result to the contents of independent memory (M), and when a condition is satisfied, returns to the start of the program.)
  [2ndF] [x=M]/[$x\neq$M]/[x<M]/[$x\leq$M]/[$x\geq$M]/[x>M]
- Checking the number of steps remaining in memory. [2ndF] [M.CK]

4. Numerical Integration Mode ($\int dx$)

① Integrand entry

Example: $\int_a^b (x^2 + 0.5x)dx$

[MODE] 1 [ALPHA] [M] [x^2] [+] .5 [ALPHA] [M]

② Numerical integration solution

Example: The lower integration limit a=2, the upper integration limit b=8, the number of subintervals n=10

[MODE] 2 [ENT] 2 [ENT] 8 [ENT] 10 [ENT]

$\int dx$	**183.**

5. Single-Variable Statistical Calculation

① Setting the single-variable statistical calculation mode [MODE] 3

② Data entry Data [×] frequency [DATA]

③ Calculating statistics

Example: To obtain the sample mean

[RCL] [$\bar{x}$]

6. Two-Variable Statistical Calculation

① Setting the two-variable statistical calculation mode [MODE] 4

② Data entry

Example: 1 [(x,y)] 4 [DATA]
5 [(x,y)] 8 [×]
3 [DATA]

n	4.

Sample data

No.	1	2	3	4
x	1	5	5	5
y	4	8	8	8

③ Calculating statistics

Example: Find Σxy

[RCL] [Σxy]

Σxy	124.

④ Regression calculations

Example: Find coefficient a and b in regression equation a+bx and correlation coefficient r

[RCL] [a]
[RCL] [b]
[RCL] [r]

a	3.
b	1.
r	1.

⑤ Calculations using statistics

Example: Find x unbiased variance (sx^2)

[ALPHA] [Sx] [x^2]

	4.

⑥ Estimation of $x(y)$ with $y(x)$

Example: Find y estimate (y') for x = 12

12 [y']

y'	15.

⑦ Data deletion

Example: Delete data 3

5 [(x,y)] 8 [×] 2 [2ndF] [CD]

n	2.

⑧ Deleting all data

[2ndF] [CA]

ERROR AND CALCULATION RANGES

1. Errors

An error will occur if an operation exceeds the calculation range on page 46, or if a mathematically illegal operation is attempted. When an error occurs the calculation cannot be continued unless the error is first cleared by pressing the [ON/C] key.

- The number following the indicator "Er" is an error code. Since this code indicates the type of error, carefully check the code number and its meaning.

2. Error Codes and Error Types

1	Syntax error • An attempt was made to perform an invalid operation. Example: 3×÷2 (AER mode)
2	Operation error • The absolute value of an intermediate or final result of a calculation exceeds 10^{100}. • An attempt was made to divide by 0. • The calculation range on page 46 was exceeded while performing function calculations, statistical calculations, or conversions/calculations with binary, octal, and hexadecimal numbers.
3	Depth error • The available number of buffers was exceeded (there are 5 buffers for numeric values and 8~16 buffers for calculation instructions). (See page 6.)
4	Memory error • Memory-related errors, such as memory overflow, or execution of a non-programmed area.

3. Calculation Ranges

- In this calculator, the calculation error is normally ±1 at the lowest digit of the displayed value (at the lowest digit of the mantissa in scientific notation) within the calculation ranges given below. However, in chain calculations, calculations that use memories (*), numerical integration, and statistical calculations, the accuracy is reduced because of error accumulation.

  * In calculations that use memories, only 10 digits of the mantissa can be stored in memory. For this reason, the magnitude of an error may increase. Since memories are used during integration and statistical calculations, errors can accumulate while the calculator performs these operations.

- Calculation ranges

  Entries and Operands

  $\pm 10^{-99} \sim \pm 9.999999999 \times 10^{99}$ and 0.

  Intermediate and Final Results

  $\pm 10^{-99} \sim \pm 9.999999999 \times 10^{99}$ and 0.

  If the absolute value of an entry, a final or intermediate result of a calculation is less than 10^{-99}, the value is considered to be 0 in calculations and in the display.

Function	Calculation range
$\sin x$ $\cos x$ $\tan x$	DEG: $\lvert x \rvert < 10^{10}$ $(\tan x : \lvert x \rvert \neq 90\ (2n-1))^*$ RAD: $\lvert x \rvert < \frac{\pi}{180} \times 10^{10}$ $(\tan x: \lvert x \rvert \neq \frac{\pi}{2}\ (2n-1))^*$ GRAD: $\lvert x \rvert < \frac{10}{9} \times 10^{10}$ $(\tan x: \lvert x \rvert \neq 100\ (2n-1))^*$
$\sin^{-1} x$ $\cos^{-1} x$	$\lvert x \rvert \leqq 1$
$\tan^{-1} x$, $\sqrt[3]{x}$	$\lvert x \rvert < 10^{100}$
$\ln x$ $\log x$	$10^{-99} \leqq x < 10^{100}$
y^x	• $y > 0$: $-10^{100} < x \log y < 100$ • $y = 0$: $0 < x < 10^{100}$ • $y < 0$: $x = n$, $(0 < \lvert x \rvert < 1: \frac{1}{x} = 2n-1,\ x \neq 0)^*$, $-10^{100} < x \log \lvert y \rvert < 100$
$\sqrt[x]{\ }$	• $y > 0$: $-10^{100} < \frac{1}{x} \log y < 100$ $(x \neq 0)$ • $y = 0$: $0 < x < 10^{100}$ • $y < 0$: $x = 2n-1$, $(0 < \lvert x \rvert < 1: \frac{1}{x} = n,\ x \neq 0)^*$, $-10^{100} < \frac{1}{x} \log \lvert y \rvert < 100$
e^x	$-10^{100} < x \leqq 230.2585092$
10^x	$-10^{100} < x < 100$
$\sinh x$ $\cosh x$ $\tanh x$	$\lvert x \rvert \leqq 230.2585092$
$\sinh^{-1} x$, x^2	$\lvert x \rvert < 10^{50}$
$\cosh^{-1} x$	$1 \leqq x < 10^{50}$

Function	Calculation range
$\tanh^{-1} x$	$\lvert x \rvert < 1$
$\sqrt{x}$	$0 \leqq x < 10^{100}$
$\frac{1}{x}$	$\lvert x \rvert < 10^{100}$ $(x \neq 0)$
n!	$0 \leqq n \leqq 69$*
${}_nP_r$	$0 \leqq r \leqq n \leqq 9999999999$* $\frac{n!}{(n-r)!} < 10^{100}$
${}_nC_r$	$0 \leqq n \leqq 9999999999$* $0 \leqq r \leqq 69,\ r \leqq n$ $\frac{n!}{(n-r)!} < 10^{100}$
→DEG D°M′S	$0°00'00.01 \leqq \lvert x \rvert < 10000°$
→ POL	$\lvert x \rvert < 10^{50},\ \lvert y \rvert < 10^{50},$ $x^2 + y^2 < 10^{100}$ $\lvert \frac{y}{x} \rvert < 10^{100}$
→ REC	$0 \leqq r < 10^{100}$ DEG: $\lvert \theta \rvert < 10^{10},$ RAD: $\lvert \theta \rvert < \frac{\pi}{180} \times 10^{10}$ GRAD: $\lvert \theta \rvert < \frac{10}{9} \times 10^{10}$
DRG ►	DEG→RAD, GRAD→DEG: $\lvert x \rvert < 10^{100}$ RAD→GRAD: $\lvert x \rvert < \frac{\pi}{2} \times 10^{98}$

* n, r: integer

Function	Calculation range
→ DEC → BIN → OCT → HEX AND OR XOR XNOR	DEC : $\lvert x \rvert \leqq 9999999999$ BIN : $1000000000 \leqq x \leqq 1111111111$ $0 \leqq x \leqq 111111111$ OCT : $4000000000 \leqq x \leqq 7777777777$ $0 \leqq x \leqq 3777777777$ HEX : FDABF41C01 $\leqq x \leqq$ FFFFFFFFFF $0 \leqq x \leqq$ 2540BE3FF
NOT	BIN : $1000000000 \leqq x \leqq 1111111111$ $0 \leqq x \leqq 111111111$ OCT : $4000000000 \leqq x \leqq 7777777777$ $0 \leqq x \leqq 3777777777$ HEX : FDABF41C01 $\leqq x \leqq$ FFFFFFFFFF $0 \leqq x \leqq$ 2540BE3FE
NEG	BIN : $1000000001 \leqq x \leqq 1111111111$ $0 \leqq x \leqq 111111111$ OCT : $4000000001 \leqq x \leqq 7777777777$ $0 \leqq x \leqq 3777777777$ HEX : FDABF41C01 $\leqq x \leqq$ FFFFFFFFFF $0 \leqq x \leqq$ 2540BE3FF

SCIENTIFIC AND CALCULATOR FUNCTIONS

Scientific functions

Function		No.
Constant	y^x, $\sqrt[x]{\ }$	2
Statistical	n, Σx, Σx^2, $\bar{x}$, σx, sx, Σy, Σy^2, Σxy, $\bar{y}$, σy, sy, x', y', DATA, CD, r, a, b	19
Conversion	→D°M′S, →DEG, →$r\theta$, →xy, DEG↔RAD, RAD↔GRAD, GRAD↔DEG, DEC↔BIN, DEC↔OCT, DEC↔HEX, BIN↔OCT, BIN↔HEX, OCT↔HEX	22
Time	arithmetic, constant (+, −, ×, ÷), STO M, RCL M, M+, M−	12
Integration	$\int dx$, entry of the number of subdivisions, entry of integration interval (a, b)	3
Priority level	Complete expression (internally retained), maximum 15 consecutive ('s and)'s, 5 pending operations	21
Trigonometric, inverse trigonometric	sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$ for each angular unit	18
Fractional	Arithmetic fractions↔decimal, mixed fraction ↔ improper fraction, constant (+, −, ×, ÷), STO M, RCL M, M+, M−	16

Function		No.
Others	sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, e^x, 10^x, ln, log, x^2, $\sqrt{\ }$, $\sqrt[3]{\ }$, $1/x$, DEG, RAD, GRAD, n!, ${}_nP_r$, ${}_nC_r$, %, +%, –%, ×%, ÷%, BIN, OCT, HEX, NEG, NOT, AND, OR, XOR, XNOR, FIX, SCI, ENG, TAB (0 ~ 9), MDF, π, EXP, RANDOM	51

Calculator function

Function		No.
Memory	STO, RCL, M+, M–, A, B, C, D, E, F	10
Arithmetic	+, –, ×, ÷	4
Constant	+, –, ×, ÷, x+? ↔ ?+x	5
Others	C, CA, +/–	3

Programming function

Function		No.
Calculation result display, formula separation	, (comma), ␣ (space)	2
Conditional expression judgment	>, ≧, =, ≠, <, ≦	6
Addressing	1: , 2:	2
Program editing	INS mode, ◄ , ► , DEL	4
Program execution	ENT	1
Other	M.CK	1

Scientific function	Calculator function	Programming function	Total
164	22	16	202

BATTERY REPLACEMENT

Batteries Used

Alkaline-manganese battery (LR44 Radio Shack Cat. No. 23-115) × 2

Notes on Battery Replacement

Batteries that are not properly handled can leak and damage the calculator. For this reason, pay particular attention to the following points.

- Be sure to turn the power off when replacing batteries.
- Replace both batteries at the same time.
- Do not mix new and used batteries.
- Use the same type of batteries.
- When installing, orient each battery properly according to the + markings as indicated in the calculator.
- Keep the batteries out of the reach of children.
- Since the original batteries were factory-installed before shipment, they may require replacement before the continuous operating time indicated in the specifications is reached.
- Exhausted batteries left in the calculator may leak and damage the calculator.
- Do not throw the batteries into a fire, as they may explode.

When to Replace Batteries

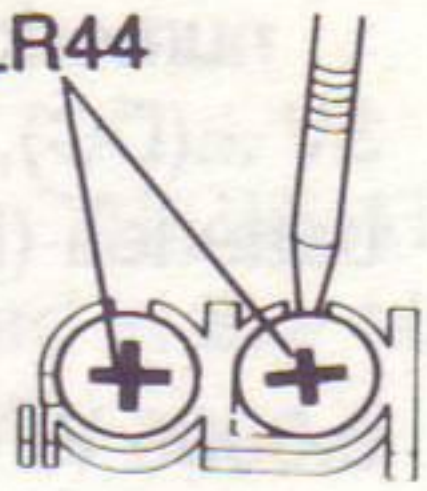
If the display becomes difficult to read, the batteries require replacement. Immediately change them by following the procedure below.

Replacement Procedure

1. Turn the power off by pressing the OFF key.
2. Remove the two screws on the back and remove the back cover.
3. Remove the used batteries by prying them with a ball-point pen or other similar pointed device as shown in the figure.

4. Install two new batteries with their positive sides facing up.
5. Replace the back cover.
6. Press the RESET switch, located on the back of the calculator.

(Figure)



Make sure that the indicator "DEG 0." appears on the display. If the display shows something other than "DEG 0.", or nothing at all, repeat steps 1 to 6.

Auto Power Off Function

If no key is pressed for approximately 10 minutes, the calculator will automatically turn off to save battery power.

SPECIFICATIONS

Product name: EC-4027

Calculations: Manual calculations (Arithmetic operations, constant calculations, memory calculations, function calculations), AER calculations, numerical integration calculations, statistical calculations, etc.

Calculation method: Expression (with priority judging function)

Internal calculations:	Mantissas of up to 12 digits * Memories (A~F and M) hold mantissas of up to 10 digits (These memories are used for statistical calculations and numerical integration.)
Power source:	3V ⎓(DC), Alkaline-manganese batteries (LR44) × 2
Power consumption:	0.0006 W
Operating time:	Approx. 1,300 hrs with alkaline-manganese batteries (LR44) when continuously displaying "55555." at 20°C. Varies according to type of battery, use and other factors. (Batteries are factory-installed before shipment. They may become exhausted before the operating time indicated in the specifications is reached.)
Operating temperature:	32°F - 104°F
External dimensions:	5/16 × 3 × 5 5/8 inches HWD (Excluding leatherette case)
Weight:	3.3 oz. (Including batteries and leatherette case)
Accessories:	Alkaline-manganese battery (LR44) × 2 (installed) and owner's manual.

RADIO SHACK LIMITED WARRANTY

This product is warranted against defects for 1 year from date of purchase from Radio Shack company-owned stores and authorized Radio Shack franchisees and dealers. Within this period, we will repair it without charge for parts and labor. Simply **bring your Radio Shack sales slip** as proof of purchase date to any Radio Shack store. Warranty does not cover transportation costs. Nor does it cover a product subjected to misuse or accidental damage.

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